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"Method and Device for nozzle-jetting Oxygen into a Synthesis Reactor"

The invention relates to a method and a device for nozzle-jetting oxygen into a synthesis reactor, e.g. for oxy-dehydration, with largely axial flow of the gas mixture through a catalyst bed.

There are a series of catalytic methods, in which oxygen is additionally fed to the treating gas in a reactor, like in the so called oxy-dehydration of propane or butane, where the oxygen is mixed with the gas flowing in into the oxy-dehydration reactors before entering into the catalyst. It has been seen that especially the irregular through-mixing of the gas flowing into the catalyst with oxygen leads to unsatisfactory results, perhaps because of soot formation above the catalyst or due to insufficient material yield, like the yield of propylene.

There is where this invention comes in with the task of clearly improving the mixing-in and mixing-through the oxygen above the catalyst particularly for oxy-dehydration process.

This task is fulfilled according to the invention with the help of a method of the type described above, where the oxygen is fed to a ring distributor system arranged above the catalyst bed and is nozzle-jetted on to the catalyst surface through several exit holes in the ring distributor at an angle inclined away from the vertical. The oxygen could be present in pure form, as air or mixed with inert gas or water vapour.

It has been seen with the help of this method a through-mixing can be achieved within a very short time <100 ms, so that the reaction time in zones with over-

stoichiometric oxygen concentrations and the non-catalytic reactions get minimised. As the mixing takes place in open air and the oxygen-rich mixing has no contact with walls or the catalyst, damage caused to materials due to the nozzle-jetted oxygen gets minimised.

Extended designs of the invention can be obtained from the sub-claims. Depending on the reactor design it could be favourable to carry out jetting of the oxygen only in the direction of the reactor center or only in the direction on to the reactor wall or even in tangential direction, whereby there is obviously a further variant, where these flow-in directions of the oxygen can be foreseen in one as well as also in the other direction simultaneously if required in different axial planes. With the different on-flow angles, while additionally equipping already existing plants one can adapt to the respective reactor design.

A method has proved to be particularly in which the jetting of oxygen takes place in tangential alignment and for each ring of the ring distributor in alternating alignment from ring to ring of the ring distributor.

In another extension of the method the jetting of oxygen takes place in a plane approximately 50-300 mm above the catalyst bed, which ensures an oxygen dwelling time of ≤ 1 second in the space above the catalyst bed.

In order to fulfil the invention also foresees a device, which has the special feature of a ring distributor consisting of several concentric ring pipes, provided with exit holes above a catalyst bed, where the exit opening are designed to give off oxygen on to the catalyst surface at an angle inclined away from the vertical.

The gas exit openings can be designed as holes or nozzles.

At this juncture reference is being made to some literature from the state-of-the-art technology. Thus DE-OS 43 33 372 publishes a manufacturing methods for olefins from methane containing gas mixtures, or the document US-5 935 489 that shows a method and a device for producing synthesis gas with partial oxidation or the US-patent documents 2 518 583, 2 809 981 or 2 954 281. From the document US-2 584 391 one can learn about jetting of a reactant in directions deviating from the vertical in order to achieve a more effective contact between solid and gas particles in a fluidized reactor belt. Mechanism for distributing fluids above or between catalyst beds are shown in the documents US-262 692, US-3 208 833 or US-3 685 971. A spiral-shaped distributor is shown in WO 01/76731-A1.

Design extensions of the invention can be obtained from the sub-claims relating to the device.

Further features, details and advantages of the invention can be obtained on the basis of the following description as well as the drawing. The following are shown:

Fig. 1 A very simplified depiction of a device according to the invention; and

Fig. 2 a detailed enlargement as sectional drawing of the ring distributor system for oxygen introduction; and

Fig. 3 & 4 Principle sketches of the flow-up direction of two jets of oxygen particles on to the catalyst bed for different meeting angles.

The oxy-reactor depicted schematically in section in Fig. 1 and generally denoted by the reference sign 1 has a gas inlet pipe 2 that centrically penetrates a horizontally arranged catalyst 3, where a gas dome 4 is formed above the catalyst bed in the reactor.

The centric gas inlet pipe 2 is surrounded by a ring distributor 5 for oxygen in pure form, as air or mixed with inert gas or water vapour, where this ring pipe 5 feeds several ring pipes 7 equipped with exit opening 6 that are arranged above the catalyst 3, the exit openings 6 are arranged in such a way that the respective oxygen jet meets the catalyst surface at an angle deviating from the vertical, whereby in Fig. 3 the vertical meeting situation is depicted and in Fig. 4 a situation according to the invention.

In Fig. 1 the oxygen entry into the ring distributor 5 is indicated only by the arrows 8; even the gas exit of the reactor is only indicated and bears the reference sign 9.

With the help of the inclined meeting direction of the oxygen jet on to the catalyst bed as indicated also in Fig. 4, among other things one can prevent a large-spaced circulation of the oxygen containing gas.

As indicated in Fig. 3 in case of vertical flow adjacent jets meet the catalyst on one another, whereby one can achieve a preventive circulation.

Of course the described design example of the invention can still be changed in several respects without departing from the basic idea; especially the meeting angle can be selected according to the type of the reactor or in some other way.